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Irrigation Quality of Surface Water of Rural Areas around Kota City, Rajasthan

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ABSTRACT

Due to the natural and anthropogenic inputs, the Chambal River which passes through the Kota city has gradually deteriorated. The assessment of surface water quality is an important aspect to understand the ecological sustainability of the river. Hence, in this study the surface water quality of Kota was evaluated using long time series data (1999 to 2016) for pre-monsoon and post-monsoon period. Data on monitored locations were collected from Public Health Engineering Department (PHED). Various physio-chemical parameters of surface water quality for River Chambal, Akelgarh water treatment plant and Sakatpura water treatment plant were examined to assess the extent of pollution and its suitability for drinking and irrigation purposes. Apart from this the seasonal and temporal variations in water supply of Kota city were observed during 2006-2016. The results imply that water quality of River Chambal is moderately polluted, hence to maintain its water quality; proper waste disposal technique should be adopted. However, drinking water supply system analysis indicates the shortage of water supply in outskirts of the city, so water transmission system need to be augmented in near future to supply additional demand in the newly developed areas in the city.

KEYWORDS: *Kota, Irrigation, Surface Water, Rajasthan, Quality, Rural Areas, Chambal, Transmission, Ecological*

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INTRODUCTION

Water is one of the largest and most available ecosystem compounds. For their survival and development, every living organism on the earth requires water. The world has now just 70% of the water on Earth. But because of the increased human population, industrialization, fertilizer use in agriculture and human activity, various dangerous substances are highly contaminated. Water pollution is calculated by the measurement of water physiochemical parameters. Physico-chemical analysis is primarily a matter of evaluating water quality for best use, such as drinking, irrigation, fishing and industrial use and of understanding complex processes, the interaction of climate and biological water processes. Water is largely used and most important natural resources in the world. For the human being as well as all the living organisms, production, human health and for the economic growth, water plays a important role. The safety is necessary for the healthy use of drinking water. Various contaminants including chemical and microbiological contaminants impact on the standard parameters of drinking water. The consistency of drinking water is poor because of these contaminants. These poor water qualities can also contribute too many human diseases, and both chemical and microbial pollutants must be checked for water quality.[1,2]

Water forms the basis of life and is a vital part of urbanization, economic growth and farming. Natural and run-off, agricultural, industrial and residential waste can be sources of pollution. Wetlands cover the major part of the earth. On the basis of current and stratification, fresh waters can be divided as standing waters and running waters1. Freshwater aquatic systems sequester a good amount of global carbon through carbon cycle. Greatest values of ecosystem goods and services per unit area of all habitats have been assigned to freshwater aquatic ecosystems.[3,4]

Comparisons with the World Health Organization and the Indian Institute of Standards for geochemical outcomes of beverage water indicate that most ground water samples do not meet the specifications of drinking water quality. Test analyzes before and after the Pre monsoon show major changes as well. The study shows that groundwater quality changes in the post-monsoon cycle can be attributed to groundwater intrusion and drainage. Therefore the safety and appropriateness of groundwater is a priority in the near future.

The contaminants affect our lives and the current pollution rate; we don't get drinkable water in accordance with established standards. Recent researches in different parts of Rajasthan have also shown the impacts on water quality. Daily monitoring are also time-consuming to monitor groundwater status and assess the contaminants. In view of this, the spatial distribution maps were created using the geographical information system (GIS) to measure water quality parameters. The distribution maps provide an overview of the ecological state of groundwater systems and define the quality requirements for surface water in future areas to be targeted at water treatments.[5,6]

Water is a fundamental unit of every person and it is basic for every single living structure and the earth wellbeing. Rivers are basic for all living life form on the earth. The current examination was led to assess water quality status of Chambal River subsequent to intersection the urban zone of Kota. The physico-chemical parameter as Temperature, pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness, Calcium Hardness, Magnesium hardness and Chloride and so on were utilized to analyse the contamination index of river Chambal at selected sites in district Kota Rajasthan statistical analysis was also be carried out for the probability of difference between populations.

Water quality of Chambal is appropriate for drinking purposes after legitimate treatment process. The Physico-chemical parameters indicated that the contamination level has under the limits prescribed by BIS and WHO. The analyzed concentrations of different parameter indicated alarming situation of contamination if this situation persists consistently then it may create a problem to human life as well as biodiversity of River. In this manner we should check water quality each half year before monsoon and prepare plans to make the river water increasingly consumable for drinking purposes, irrigation and for healthy wild life.[7,8]

The physicochemical characteristics of water samples obtained from ten different sampling locations of Chambal River along Kota City, Kota during pre-monsoon and post monsoon season of years 2018-2019 are shown in Table-1 and Table-2 and statistical data was also calculated.

Table-1 The Physico-chemical parameters of water sample from different location of Kota district. (Pre Monsoon) 2018-2019

Parameter	Name of Samples									
	CWS 1	CWS 2	CWS 3	CWS 4	CWS 5	CWS 6	CWS 7	CWS 8	CWS 9	CWS 10
pH	7.2	7.6	7.4	7.2	7.6	7.5	7.6	7.2	7.5	7.2
Temp. (^{0}C)	32	32	31	31	32	31	32	32	32	31
Conductivity (µS)	290	292	298	285	302	289	287	335	302	285
Turbidity (NTU)	7.8	8.5	6.3	7.5	7.6	6.5	6.6	5..6	7.8	6.5
TDS (mg/L)	598	600	589	581	579	588	599	555	589	586
T. Alkalinity (mg/L)	136	158	156	135	133	162	152	132	138	145
T. Hardness (mg/L)	136	158	156	135	133	162	152	132	138	145
Chloride (mg/L)	215	222	226	235	215	244	257	288	237	249
Nitrates (mg/L)	8.2	7.3	7.8	7.4	8.2	8.1	8.5	8.5	7.8	7.7
Sulphate (mg/L)	379	396	421	376	394	389	398	391	345	365
Fluoride (mg/L)	1.1	1.2	1.3	1.2	1.2	1.3	1.2	1.3	1.1	1.2
D O (mg/L)	6.3	6.5	5.4	5.8	6.8	5.9	5.8	5.9	6.4	5.9
C O D (mg/L)	9.5	9.6	10.5	11.6	12.5	9.8	9.7	10.6	11.5	12.5
B O D (mg/L)	2.4	2.7	3.4	3.2	2.9	3.7	4.1	3.6	2.9	3.6

Table-2 The Physico-chemical parameters of water sample from different location of Kota district. (Post Monsoon) 2018-2019

Parameter	Name of Samples									
	CWS 1	CWS 2	CWS 3	CWS 4	CWS 5	CWS 6	CWS 7	CWS 8	CWS 9	CWS 10
pH	7.2	7.1	6.95	7.6	7.8	7.4	7.2	7.3	6.09	7.98
Temp. (^{0}C)	30	30	30	31	30	31	30	31	30	31
Conductivity (µS)	231	213	215	266	244	230	215	215	288	256
Turbidity (NTU)	4.5	3.8	4.9	5.7	4.8	5.2	4.3	3.9	4.8	6.4
TDS (mg/L)	554	590	543	575	565	572	545	565	574	577
T. Alkalinity (mg/L)	109	99	114	112	90	98	104	90	105	110
T. Hardness (mg/L)	110	110	98	115	131	125	115	117	110	109
Chloride (mg/L)	211	232	214	219	225	219	254	247	248	252
Nitrates (mg/L)	9.8	9.7	8.5	7.2	8.5	9.4	8.1	7.6	9.4	7.5
Sulphate (mg/L)	374	376	412	362	378	369	375	366	382	387
Fluoride (mg/L)	1.1	1.2	1.3	1.2	1.2	1.3	1.2	1.3	1.1	1.2
D O (mg/L)	4.5	5.6	4.5	4.7	4.6	6.5	5.4	4.8	5.9	4.5
C O D (mg/L)	6.5	6.6	6.9	8.1	6.6	6.5	5.6	6.9	5.9	6.8
B O D (mg/L)	1.8	2.1	2.6	2.4	3.5	2.4	2.6	2.8	2.1	2.9

Discussion

Kota with second highest HDI in the state after Ganganagar has a strong presence in Indian map for its coaching institutions for medical and engineering entrances exam. It is known as the education city of India. It is situated on the bank of the Chambal river at the south-eastern part of Rajasthan. The total area of Kota is 5217 km2 and has an average height from sea level is 271 feet. The district is divided into 08 Sub-Districts, 11 Towns, 05 Panchayat Samitis, 156 Gram Panchayats, and 874 Villages. The total population of the district is 19, 51,014 comprising 39.69% rural and 60.31% urban population (Government of India, 2011). Kota comes under humid southeastern plain (V) agro-climatic zones with 420.9 thousand hectares cultivable area. The Rice, Jwar, Pearl Millet, Groundnut, Wheat, Maize, Sesame, Urad, Soybean, Coriander, Chickpea, Flax Seeds, Barley, Mango, Guava, Gooseberry, Lime, Tomato, Brinjal, Cucumber, Ladyfingers, And Orange are leading crops sown in the Kota district. Kota secured the first rank in the production of flax seeds in the state and coriander is exported from the district. It has 04 KUMS and 07 submarket yards for agriculture marketing. There are three warehousing centers situated in Itawa, Ramganjmandi, Sultanpur with 4400 MT, 9650 MT, 5400 MT capacity respectively. Five cold storages have been established for storing agriculture produce mainly orange and coriander at Kota. The highest percentage of the net area irrigated to the net area sown was recorded in Kota District with 95.48 percent whereas the lowest percentage was recorded in the Churu Dis-trict with 12.60 percent. [9,10] Kisan Bhawan, Agro Food Park (Ranpur), Agro-food processing units, Export Zone for Coriander and Agriculture University have been established in the district for the agricultural development in South-East and Eastern Rajasthan.

The present study based primary and secondary data. Agricultural workers suffer from a multiple burden on their time due to their home and income earning responsibilities. The development and dissemination of new technology can solve the problem of unemployment and helps in eliminating the poverty. It can be concluded from above discussion that the majority of farmers have basic facilities like house and drinking water. Physical environment of the state plays critical and significant role in almost every phase of agricultural activity. The performance of agriculture sector in the state is quite satisfactory but there are several challenges in agriculture. Most of the challenges are adverse climate and implementation of agro-development plans. So it is quite essential that Government and Farmers of Rajasthan both should be conscious about the overall development of agriculture sector and tackles the challenges in agriculture. However, the governments played major roles to improve the modality of agricultural marketing in the state but they should make promotional strategies according to the degree of development of the particular region.[11,12]

Results

The physicochemical assessment of pond water samples of ganeshganj of Kota District was used to evaluate the suitability of pond water for drinking, industrial and agricultural purpose. A sensitivity analysis showed that now a day's pond water quality deteriorated. Main factors affect the hydrochemistry of pond water of Kota District is

wastewater and agriculture activities. Pondwater source is considered the main water supply source for all kind of human usage in the villages of one tehsils of Kota district (domestic, agricultural and industrial). The tropical status of a water body can be evaluated by its physicochemical parameters which would help to formulate the control measures and monitor the impact of human activities on biological diversity of the water body. In the present study it is clearly seen that the physicochemical characteristics of water is greatly influenced by the anthropological activities and hence it directly affects the phytoplankton population residing in water bodies.

The need for Kota's drinking water is mainly addressed by surface and ground water supplies, which are both important for domestic, industrial and farm purposes. And so it is because of the nearby Chambal River the value of quality versus quantity.

The consistency of drinking water is low because of these pollutants. Often such low water quality causes many diseases in humans so that both chemical and microbial pollutants have to be screened for the consistency of the water. During the study, it was determined, according to WHO (1971) and BIS (1991), that the maximum number of physical and chemical parameters is within the desired limit.[13,14]

This study showed a lack of an adequate treatment and drainage system in Kota which leads home, industry and so on to the life line of the city of Chambal. The sewage lines are extremely necessary for transport to the wastewater treatment plant (STP) via the city's sewages networks. This analysis also highlights the fact that, according to IS 4764:1973 and IS 2490:1981, the parameters BOD, COD and TDS of all samples from different locations alarmingly exceed the limits stated. Water-based plants and animals can suffer heavy damage by exceeding their respective limits.

Table-3: Wastewater Analysis Physical and Chemical Specifications

Sample Code	Parameters (in mg/l, except pH and temperature)					
	pH	Temperature	DO	BOD	COD	TDS
S-1	7.9	22.4	2.97	314	813.26	1500
S-2*	7.4	26.3	5.51	25	59	300
S-3	7.9	30.1	0.31	502	1340.34	1715
S-4	7.1	30.4	0.21	319	749.65	1500
S-5	8.2	32.5	2.37	328	1049.6	1610
S-6*	7.5	30.7	6.7	28	63	312
S-7	7.3	27.4	1.8	412	1054.7	1690
S-8	6.7	28.2	2.17	325	763.75	1611
S-9	8.3	22.4	2.9	110	262.9	590
S-10	6.9	30.9	3.7	150	363	612
S-11	8.0	31.4	3.42	146	421.94	530
S-12*	7.3	30.8	6.2	27	65	328
S-13*	7.8	32.2	3.7	80	191.2	523
S-14	7.4	30.7	3.1	105	327.6	711
S-15	7.9	31.1	2.97	110	285	810

Conclusions

Surface water is an essential natural resource that plays a vital role in human life and has an important role in drinking, irrigation and economic sectors. The quality of river water is crucial in crop production, maintenance of soil productivity, and protection of the environment. The quality of surface water can be affected by different types of activities induced by human, which result from industrial wastes, agricultural processes, municipal and residential activities. The quality assessment of surface water is essential for irrigation purposes. The present study assessed the water quality of Chambal River near Kota city for irrigation purposes.[15,16] The water

quality is analysed for irrigation with the help of IWQI (irrigation water quality index). It is calculated by physiochemical parameters such as EC, Na+, Cl-, HCO3- and SAR. Various irrigation water quality indices such as sodium absorption ratio (SAR), Kelly ratio (KR), soluble sodium percentage (SSP), sodium percentage (Na%), permeability index (PI), magnesium hazard (MH), Residual sodium carbonate (RSC) and Residual sodium bicarbonate (RSBC) are computed to define overall category of irrigation water. The observation period for this work from 1 January 2019 to 31 December 2020. The results outcome from this study that the IWQI values fall under the category of "Good and Suitable" for irrigation purposes. [17,18]

This research is an earlier sign of regulating agencies to control and manage river water pollution. Stakeholders should bring new projects to stop the flow of wastewater streams into the Chambal River without treatment. All wastewater streams should be treated in CETP before discharging downstream of the Chambal River[19]

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